PATENT SPECIFICATION (11) 1 554 019

(21) Application No. 16648/77 (22) Filed 21 April 1977 (19)

(31) Convention Application No. 2 622 702

(32) Filed 21 May 1976 in

(33) Fed. Rep. of Germany (DE)

(44) Complete Specification published 17 Oct. 1979

(51) INT. CL.² E21B 1/06

(52) Index at acceptance

E1F 31C 31D1 31DX

1 554 019

(54) METHOD AND APPARATUS FOR ESTABLISHING A PIPE COMMUNICATION WITH BURIED PERSONS

(71) I, PAUL SCHMIDT, a German citizen, of Winterberger Strasse, 70, 5940 Lennestadt 14, West Germany, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to methods of and to apparatus for forming holes through the ground, for example for establishing a pipe communication with buried persons, especially miners trapped by roof falls in mines.

Trapped or buried persons must not only be supplied as rapidly as possible with light, food, medicaments and fresh air, but it is also necessary to set up very rapidly speech communication with them, since it has been found that after about 24 hours, the nervous effects upon trapped persons become so great that they have practically reached the limit of their physical endurance.

To save trapped miners, a so-called life-saving bomb is frequently used. This is a rocket-like hollow object, by which one miner at a time can be rescued through a tube incorporated into a hole bored in the ground. In order to place the tube, a bore of about 50 cm diameter must be formed in the soil by means of a large bore-hole appliance and the bore is then lined with a tube. This known method for rescuing trapped or buried miners suffers from a disadvantage in that, for large drilling diameters, the bore-hole must be substantially vertical. The boring of such a hole is not only difficult and time-consuming, but is also accompanied by the risk that the enclosed space in which the miners are trapped may not be intersected by the hole and moreover, on account of the great depth, the control of the drilling rig and its advance can only be inaccurate.

Because of the risk of caving in, a tunnel can moreover not be formed directly horizontally through the fallen debris, but instead if a tunnel is to be driven, a creep shaft must first be excavated in the floor of the caved-in part of the mine.

The aim of the present invention is to provide a method, by which in a short time and in a simple manner, a reliable pipe communication can be established with, for example, trapped miners or other buried persons.

According to the invention, we provide a method of forming a hole through the ground with a self-propelled displacement hammer and lining the hole with a pipe, the method comprising the steps of fixing the front end of a pipe to the rear of the hammer, and causing the hammer to advance through the ground and to displace the ground laterally, the pipe being pulled by the hammer into the hole as the hammer advances, and simultaneously pushing the rear end of the pipe by means of a hydraulic ram which is anchored to the ground at the start of the hole.

It is fundamental to the method of the invention that the ground in which the hole is formed is not drilled out, but is displaced sideways, so that a compaction and thus strengthening of the wall of the hole results and the pipe which serves for supporting the wall can be introduced into the hole. In this manner, a reliable pipe communication to trapped miners or other buried persons is very rapidly established. The hole can be driven in any desired direction by the method in accordance with this invention, that is vertically, horizontally or at an inclination.

It is of special advantage if the hole is formed through fallen debris by which the persons are buried. It has indeed been found that, with the method of this invention, fallen debris which, in a mine, may comprise in addition to rock, also steel plates, and timber planks and beams, does not collapse further when the hole is formed, but retains its shape, so that subsequently pipes can be pulled and pushed directly into the hole.

Apparatus for carrying out the method of this invention advantageously comprises, in

accordance with another aspect of the invention, a self-propelled displacement hammer having at its rear end a plug connection for a pipe to enable the front end of the pipe to be fixed to the hammer so that the pipe follows the hammer through the hole formed by the hammer, and a device which has means for anchoring it to the ground and a hydraulic ram having an annular piston with an internal bore which is larger in diameter than the external diameter of the pipe, the annular piston having at its front end clamping means for gripping the rear end of the pipe.

The displacement hammer which preferably comprises a cylindrical casing, a conical percussion boring and displacement tool disposed at its forward end, a percussion mechanism in the casing to act on the tool and a connection sleeve disposed at the rear end of the casing and forming the plug connection, is preferably pneumatically operated and drives itself forward through the ground to form the hole.

The pipe preferably has substantially the same external diameter as the casing, so that it completely fills the hole formed by the hammer. The pipe which is preferably thin-walled and of steel may be sub-divided into component lengths and equipped with flush joints of the drill pipe type to avoid any unnecessary frictional resistance as they are inserted into the hole.

The percussion tool can be fixed to the casing in a stationary manner. It is preferably, however, displaceable in the casing and the step-shaped annular cutters, which become filled up in soft material, develop their full cutting action in the hard debris.

As the work required to form the hole, which is provided by the displacement hammer, increases and as the hole advances, an increased frictional resistance develops on account of the pipes which are introduced into the hole. This friction, which for example in a drive of 25 m length may be from 6 to 10 Mp, must be statically balanced. This is done by the device which has means for anchoring it to the ground and a hydraulic ram having an annular piston with an internal bore which is larger in diameter than the external diameter of the pipes.

In one especially advantageous embodiment of the apparatus, the clamping means is a releasable clamping tongs comprising toothed pipe clamping jaws. In this way, the pipes can be reliably gripped and pushed forward into the hole.

Preferably, the cylinder of the ram is adjustable in height and laterally relative to a base place which forms part of the means for anchoring the device to the ground. The direction of the hole which is to be formed can in this way be accurately set. A reference frame arranged to be mounted on the displacement hammer, and an alignment rod may also serve for this purpose.

The ram may be driven by a hydraulic pump which is in turn driven by a compressed air motor.

A pressure regulating valve is with advantage disposed in a compressed air supply line leading to the compressed air motor. By means of this pressure regulating valve, the air pressure can be infinitely adjusted, so that the hydraulic pressure at the pump also rises and falls accordingly, that is to say the pressure in the cylinder of the ram is infinitely adjustable.

An example of a method and of apparatus in accordance with the invention will now be described with reference to the accompanying drawings, in which:—

Figure 1 is a diagrammatic perspective view of the apparatus as seen from the rear and one side and showing the apparatus at the start of an operation to drive a hole through a wall of debris; and,

Figure 2 is a view similar to Figure 1 but from the rear and other side of the apparatus and showing the apparatus at a later stage of the operation.

A pipe communication is to be established through a wall of debris 1 in a mine gallery, which is not shown, to form a supply line to trapped miners. This is done by means of apparatus consisting of a displacement hammer 2, which in turn comprises a cylindrical casing 3 with a percussion bit 4 disposed at its forward end. The percussion bit 4 is constituted as a longitudinally movable displacement and chisel head, comprising step-shaped, concave annular cutters, and is driven percussively into the debris 1 by pneumatic operation of a piston within the casing 3. From the rear end of the casing 3 of the displacement hammer 2, a compressed air hose 5 leads to a compressed air source, not shown. At the rear end of the casing 3, there is a plug connection 6 in the form of a sleeve 7, to which can be attached a tube 8, shown in broken lines in Figure 2. Further tubes with suitable couplings can be attached to the tube 8. The tubes 8 have an external diameter which is substantially equal to the diameter of the cylindrical casing 3 of the displacement hammer 2.

The apparatus also comprises a device 9 resting on a base plate 11, which is firmly anchored to the ground. The device 9 comprises a ram 12, the piston of which is annular and the cylinder 13 of which is adjustable in height, inclination and in lateral direction on the base plate 11. Adjustment elements 14 and 15 serve this purpose. At the end nearest to the fallen debris 1, the device 9 has a clamping tongs 16 with, preferably toothed, clamping jaws

17, which, in operation, grip tubes 8 and push them into a duct formed in the debris 1. The device 9 serves for statically accepting the frictional resistance resulting from the friction between the tubes 8 and the debris 1, which for example with tubes having an external diameter of 95 mm and an internal diameter of 85 mm amounts to from 6 to 10 Mp for a length of 25m. The cylinder 13 of the ram 12 is connected by a line 18 to a hydraulic pump 19, which in turn is driven by the drive shaft of a compressed air motor 22. The air pressure of the compressed air motor 22 can be infinitely adjusted by means of a pressure regulating valve 23 incorporated in an air line 21, thus enabling the hydraulic pressure in the cylinder 13 of the ram 12 to be correspondingly regulated so that it is also infinitely adjustable. The drive of the ram 12 furthermore comprises an oil tank with a filter, a compressed air service unit having a water separator, a pressure regulator, a valve and spray lubricator and a switch-over device for operating the ram 12 in forward and rearward drive.

The device is furthermore complemented by a reference frame with a prism disposed at the foot, by which the reference frame can be set on the displacement hammer 2. In conjunction with the reference frame, an alignment rod is used for directing the displacement hammer 2, this rod being set up on the side of the hammer remote from the debris 1 at a specific level in accurate alignment with the required direction of the bore. Since the reference frame possesses, at an accurately determined level, a telescopic sight with crossed hairs, it is possible by parallel displacement accurately to set up the reference frame and thus accurately to align the displacement hammer 2.

When an emergency arises, the base plate 11 is anchored to the ground directly in front of the fallen debris 1, either by means of a hydraulic strut as commonly used in mining, by which the base plate is pressed on to the floor, or by means of driven-in anchor pins. The base plate 11 is aligned roughly on to the boring axis. Then the displacement hammer 2 is pushed through the annular piston of the ram 12 to the debris 1. Next, the power unit is connected to the compressed air source and the line 18 to the cylinder 13 of the ram 12.

The component pipe lengths 8 are next pushed over the compressed air hose 5 of the displacement hammer 2 to the required number and the compressed air hose is coupled to the displacement hammer 2. The boring axis is then determined and the alignment rod is set on the side of the hammer which is remote from the debris 1. By means of the reference frame, the device 9 is then aligned on the alignment rod, this being done by means of the adjustment elements 14, 15.

Next, an air valve at the displacement hammer 2 and also at the device 9 or power unit, is opened. The compressed air is initially throttled for the power unit, so that the applied pressure does not rise unnecessarily high. After the displacement hammer 2 started to penetrate the debris, the pipes 8, which possess thin flush joints, are pushed into the clamping tongs 16 of the hydraulic ram 12 and are automatically gripped by these tongs and are then pushed forward into the bore-hole being formed in the debris 1.

For additional reliability, a steel cable, not shown, can be attached to the displacement hammer and passed through the pipes 8. By means of a cable clamp, which is clamped on to the cable after the last pipe 8, a strong connection can thus be made for the entire string of tubes.

The operation is continued until the bore-hole and the pipes reach the space in which the miners are trapped.

WHAT I CLAIM IS:—

1. A method of forming a hole through the ground with a self-propelled displacement hammer and lining the hole with a pipe, the method comprising the steps of fixing the front end of a pipe to the rear of the hammer, and causing the hammer to advance through the ground and to displace the ground laterally, the pipe being pulled by the hammer into the hole as the hammer advances, and simultaneously pushing the rear end of the pipe by means of a hydraulic ram which is anchored to the ground at the start of the hole.

2. A method according to claim 1, in which the hole is formed through fallen debris in a mine.

3. Apparatus for carrying out the method in accordance with claim 1, the apparatus comprising a self-propelled displacement hammer having at its rear end a plug connection for a pipe to enable the front end of the pipe to be fixed to the hammer so that the pipe follows the hammer through the hole formed by the hammer, and a device which has means for anchoring it to the ground and a hydraulic ram having an annular piston with an internal bore which is larger in diameter than the external diameter of the pipe, the annular piston having at its front end clamping means for gripping the rear end of the pipe.

4. Apparatus according to claim 3, in which the displacement hammer comprises a cylindrical casing, a conical percussion boring and displacement tool disposed at its forward end, a percussion mechanism in the casing to act on the tool and a connection

sleeve disposed at the rear end of the casing and forming the plug connection.

5. Apparatus according to claim 4, in which the tool comprises a chisel bit and step-shaped concave annular cutters, the tool being axially displaceable in the casing.

6. Apparatus according to any one of claims 3 to 5, in which the displacement hammer is pneumatically operated.

7. Apparatus according to any one of claims 3 to 6, in which the clamping means is a releasable clamping tongs comprising toothed pipe clamping jaws.

8. Apparatus according to any one of claims 4 to 7, in which the cylinder of the ram is adjustable in height and laterally relative to a base plate which forms part of the means for anchoring the device to the ground.

9. Apparatus according to any one of claims 4 to 8, in which the ram is driven by a hydraulic pump which is in turn driven by a compressed air motor.

10. Apparatus according to claim 9, in which a pressure regulating valve is disposed in a compressed air supply line leading to the compressed air motor.

11. A method according to claim 1, substantially as described with reference to the accompanying drawings.

12. Apparatus according to claim 3, substantially as described with reference to the accompanying drawings.

For the Applicant.
GILL, JENNINGS & EVERY,
Chartered Patent Agents,
53/64 Chancery Lane,
London, WC2A 1HN.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1979.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.

1554019 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale

FIG. 1

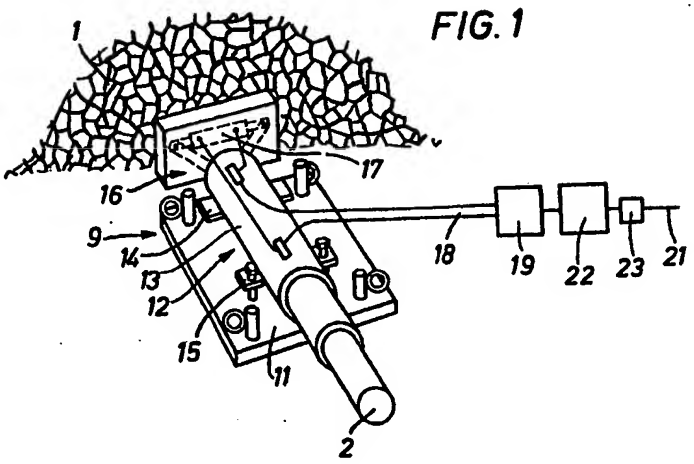

FIG. 2